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ABSTRACT

A study to assess the feasibility of the use of low frequencies for teaching foreign language to the hearing impaired is described. The subjects were unimpaired Japanese students, aged 18 and 19, in beginning French language study. Recorded sentences translated into English, French, and Mandarin Chinese were combined in various ways and presented to the students through filters eliminating frequencies above 300 Hz. The filters allowed only prosodic features such as rhythm, intonation, pauses, and accentuated versus non-accentuated syllables to be perceived, without phonemes or meaning. Subjects were given some training in low-frequency listening. Results show that perception of the Chinese language was better than that of English or French, but also that in all languages, significant low-frequency perception of prosodic features occurred. This suggests that perception of information transmitted at low frequencies could develop naturally and could perhaps be further developed by external means. (MSE)

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Hearing Foreign Languages through Low Frequencies

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In order to introduce the present topic, one must start by dealing with the reeducation of deaf children. Children suffering from profound sensorineural deafness very often have some hearing zones left around 500 albeit 250 Hz or below. (See Fig. 1) Huizing (1959) and Watson (1961) in two different surveys showed that between 95 and 97% of these children living in boarding schools retained some residual hearing, mostly below 500 Hz.

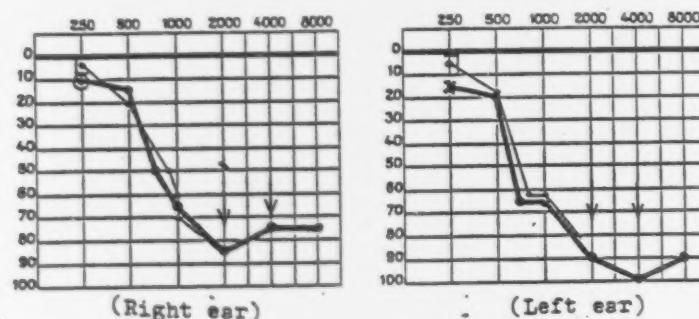


Fig. 1 Typical tonal audiogram of the residual hearing of a deaf child, suffering from sensorineural deafness (Portmann and Portmann, 1972, p. 310)

Therefore, it does not come as a surprise if reeducators of the profoundly deaf children were, and still are in disagreement how to find proper means to help these children. They have been, I would say, almost forced to have recourse to low frequencies in the face of failure of other means of reeducation. Suffice it to say that the area of hearing is divided in the following way. Below 300 Hz there is the so-called infra-sound zone; between 300 and 3000 Hz, the conversation zone where the phonemes of all languages are perceived; around 12000 Hz, the zone of discomfort; and finally around 20000 Hz the zone of pain. (See Fig. 2)

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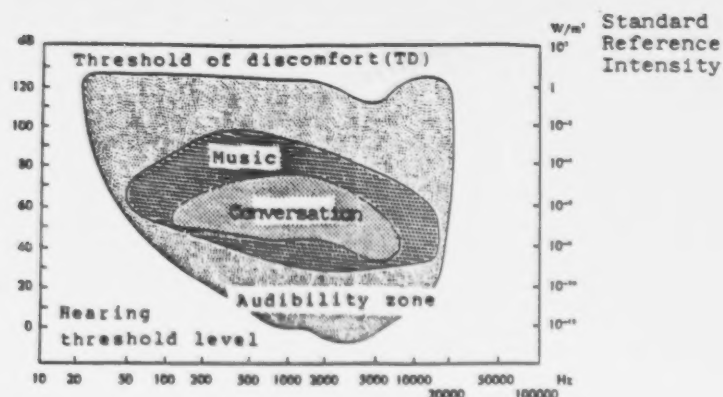


Fig. 2 Human hearing field (Wegel Curve corrected by Bilsom, Rakowska-Jaillard, 1982, P. 18)

Naturally this topic will help teachers of foreign languages to better understand the eventual role played by low frequencies, but in the present article, I will limit myself to the field of foreign languages.

Role of low frequencies

To begin with, a brief presentation of the importance of the role of low frequencies in language learning is necessary. As early as fifty years ago, in 1938, Dr. Petar Guberina stressed the importance of rhythm and intonation in producing and perceiving speech. As a result of his experience and research, he suggested that low frequencies are the primary vehicle to transmit these basic elements of speech (1964). That is why in any apparatus designed in accordance with this methodology (the Verbo-tonal Methodology), you will necessarily find filters going as low as 0.5 Hz. The reasoning behind this is the same as the one intended for the training of deaf children, aphasia patients, and people suffering from speech handicaps:

In the early 1950's he [Guberina] began to apply these two principles [rhythm and intonation] to the habilitation of deaf children who have hearing only in the low frequencies. He reasoned that the brain would function best if it were to receive the auditory stimuli for which the ear is most sensitive; moreover, it would be enriched (in Piaget's terms) by these optimal stimuli; and with time and training, it would be prepared to respond to more difficult tasks, i.e., less favorable stimuli. (Asp and Guberina, 1981, p. 2)

Concretely this means that students trained with low frequencies will be in a better position from the viewpoint of their brain to learn foreign phonemes, and to hear foreign languages as they are (that is, different from their mother tongue). It is as if both physical and psychological problems affecting these students begin to disappear. Low frequencies have the effect of enhancing memorization, a better hearing of the frequencies where phonemes of human speech are found, and a better functioning of the brain. Words are here inadequate because at this level we cannot say people "hear" in the same way as they do in the zone of conversation. The whole body as such, and not just the ear alone, is involved. More than hearing sense, kinesthesia, the sensation of one's own muscular activity, is working.

Dr. H. Trocmé (1973, p. 51) noticed that when her students were trained with low frequencies they showed a better regulation of their breathing. This observation is very important, since the students used to become breathless after three or four syllables. Experience shows that young learners do not know how to regulate their rhythmic or breath groups; they also do not know which syllables they have to stress and which ones not to stress. Low frequencies draw the learner into the flow of rhythm without his noticing it. Trocmé proposes as an explanation the fact that they were probably more preoccupied with the semantic or syntactic rules than the acoustic side. By using low frequencies, articulatory and respiratory efforts become naturally regulated on their own accord and words lose their own individuality to disappear within a rhythmic group. Words do not exist anymore, only syllables or rhythmic groups.

At first, it seems hard to believe that low frequencies below 300 Hz could help the correct perception and articulation of phonemes whose frequencies are found above 300Hz, mostly around 1000 or 2000 Hz. But this is true for all phonemes, especially in the case of the correct timbre of vowels, in the pronunciation of /r/ and /l/, two liquids that can be considered very close to vocalic sounds. Other rhythms and other rhythmic structures would have involved different phonemes and different languages. As a scientific explanation for this phenomenon, we have to acknowledge that phonemes also possess some frequential elements even in the infrasonic zone. (Ling, 1964, p. 728, 1965, p. 236; Franklin, 1969, p. 365; Rosenthal et al., 1975)

Finally we come to a third result. Low frequencies are particularly efficient to transmit rhythm and intonation which form the basis, the structural background of every language. There is no better way of perceiving them other than the frequencies below the zone of conversation. This point has been stressed very often by different searchers (Ling, 1964, p. 728; Franklin, 1979, p. 175; Broesterhuizen et al., 1981, p. 145; Guberina, 1985, p. 47). That is why one is entitled to say that

We attach the utmost importance to low frequencies that transmit the best rhythm and intonation. It is possible to base speech on rhythm because rhythm is altogether a biological and physiological phenomenon. By introducing speech through its rhythmical structure, we affect man in depth. We condition him anew through what is most deeply entrenched in him, and from a pedagogical viewpoint, we keep him away for a limited period of time from the situation where he hears phonemes rather well --the "direct channel"-- but less clearly hears rhythm and intonation. Later on this rhythm and intonation will enrich his possibility of listening, and he will hear within the same spectrum both his mother tongue and the foreign language. (Guberina, 1973, p.11, my translation)

Background to the present study

Coming now to the problem of learning foreign languages, I would like to introduce some of the research concerning the topic of low frequencies. First there is the study of Cohen, Starkwether (1958) who used a 600 Hz low-pass band. Under these circumstances, it is difficult to accept the results of their research since, as I said above, this zone partially covers the lower section of the conversation zone. Three other studies have extracted the fundamental frequencies of amplified filtered texts and with the help of a generator have transformed them into pulse trains, Atkinson (1968), Bonte (1975), or into a sort of "buzz" tone (Ohala, Gilbert, 1979). As far as I know, only Bush (1967) and Richardson (1973) called on low-pass filtered signals for their experiments. Another study (Maidment 1976) used a laryngographic apparatus for analysis.

Some experiments have introduced the mother tongue among the languages to be examined, others have avoided it. Some presented long texts, others very short ones, and finally some others presented both (Ohala, Gilbert). Some researchers have examined phonetically very similar languages, for instance White and Black English (Richardson) or American English, British English, and Indian English (Bush). Other researchers, on the other hand, purposely chose very different languages, for instance, English, Cantonese, Japanese (Ohala, Gilbert). In some experiments, the subjects were given a certain period of training before the beginning of the experiments, and in other cases, the experiment started immediately after two or three trials. Finally, most of the experiments used a text that was read; only one (Ohala and Gilbert) presented a free conversation. Against such a background, it is difficult at the present time to make a useful comparison between these attempts or use them as references for the present research.

The purpose of my research is twofold: to know whether Japanese students, beginners of French language, could identify the rhythm and prosody of French

- 1) without any previous training,
- 2) with only the information provided by filters without any further transformation.

Method

There were 54 subjects for the first and second tests, and 47 for the third one. 7 subjects were then eliminated since they had not understood the requirements well for their particular test. The subjects were 18 or 19 years of age, were specialized in the study of the French language, which they had studied for three months on an average of ten hours per week according to a structuro-global audio-visual (SGAV) method, "De Vive Voix". One characteristic of this method is that special care is taken to secure a perfect recording, specially for the prosody of the French language.

For Test I, students had two choices:

- a) an English sentence followed by a French one (EF)
- or b) a French sentence followed by an English one (FE).

In Test II, the students were faced with a quadruple choice:

- a) two French sentences (FF)
- b) two English sentences (EE)
- c) an English sentence followed by a French one (EF)
- or d) a French one followed by an English one (FE).

Finally, the students had six possibilities of choice in Test III:

- a) French-English-Mandarin (FEM)
- b) French-Mandarin-English (FME)
- c) English-French-Mandarin (EFM)
- d) English-Mandarin-French (EMF)
- e) Mandarin-French-English (MFE)
- or f) Mandarin-English-French (MEF).

There were ten sentences for each test, 30 altogether. They were registered on a Compact disk (SONY CD 502 ES). Their meaning was more or less linked with the language of tourism. For instance, "I'd like to change 100 dollars", "I'm checking out now", recorded in English, French and Chinese. The presentation was a haphazard one.

Each choice set was presented twice on a low-pass band of 300 Hz with a slope of 60 dB. The filter apparatus was specially assembled for this experiment by Hideaki Tomoyori. I repeat that, in this way, only prosodic features such as rhythm, intonation, pauses, accentuated versus non-accentuated syllables, etc., could be perceived; phonemes and meaning of these stimuli were eliminated.

The subjects had no special training in the listening to French below 300 Hz during their three months of schooling. However, before each test, in order to familiarize them with this new way of listening, a brief training session was given in the following way. Two sets of sentences similar to the ones to be used in the tests were presented twice non-filtered, then twice filtered in each of the following steps:

- 1) with a 300 Hz low-pass filter, 60 dB par octave combined with a high-pass filter of 3000 Hz at 30 dB per octave.
- 2) the same, except that the high-pass had a roll-off of 40 dB.

3) the same, except that the high-pass had a slope of 60 dB per octave.

4) finally the low-pass filter alone.

The two chosen sentences used for pre-testing were: "It's too expensive for me. Can't you make it cheaper?" and "How much are they together?"

Results

These are the results I obtained from the tests. The symbol * is followed by the number of correct responses. E means English; C, Chinese; and F, French. The numbers preceeding these symbols refer to the sentences in the Annex 1.

Stimuli	Responses	
	F-E	E-F
1. 6F-4E	* 35	19
2. 3E-1F	28	* 26
3. 2F-2E	* 38	16
4. 4F-9E	* 20	34
5. 7F-3E	* 44	10
6. 1E-5F	7	* 47
7. 7E-8F	11	* 43
8. 3F-8E	* 38	16
9. 6E-9F	17	* 37
10. 8F-5E	* 37	17

Fig. 3 Results of Test I, 54 subjects,
average discrimination, 67.6%

Stimuli	Responses			
	F-F	F-E	E-F	E-E
1. 2F-3E	8	* 16	21	9
2. 4F-6F	* 18	10	18	8
3. 1E-7F	28	3	* 23	0
4. 9E-6F	9	11	* 22	12
5. 5F-2E	16	* 29	2	7
6. 1F-7E	5	* 15	17	17
7. 9F-4F	* 19	14	9	12
8. 6E-9E	9	17	19	* 9
9. 7E-8F	15	8	* 26	5
10. 3F-8E	16	* 19	12	7

Fig. 4 Results of Test II, 54 subjects,
average discrimination, 36.3%

Stimuli	Responses					
	F-E-M	F-M-E	E-F-M	E-M-F	M-F-E	M-E-F
1. 4F-6M-9E		* 30		17		
2. 5F-8E-3M	* 37		10			
3. 7M-1F-5E					* 18	29
4. 6M-6E-9F	1		1		16	* 29
5. 2E-7F-1M	4		* 43			
6. 7E-2M-1F		22		* 25		
7. 9F-4E-9M	* 36		11			
8. 5M-2F-1E					* 31	16
9. 2M-3F-2E	2	3	4	2	* 27	9
10. 8E-8M-8F		12		* 35		

Fig. 5 Results of Test III, 47 subjects,
average discrimination without Mandarin, 66.2%

Test I, where an average discrimination of 67.7% was reached, is above the chance level of 50% and is therefore statistically significant ($p < 0.005$). Considered from a chance level, the discrimination of Test II would have been 25%. With 36.3%, it is above this level and is therefore also statistically significant ($p < 0.005$). In Test III, one accommodation had to be made. The Chinese language was recognized almost 97% of the times. This could be attributed to its particular rhythm, its rapid change of tones, its speed --all cues that made Chinese melody easily recognizable. If we omit Mandarin from Test III and take into consideration only English and French, we come to a result quite comparable with the one obtained in Test I, 66.2% and 67.6% in Test III. All three tests have reached statistical significance and Test III confirms what was shown by Test I.

On the whole one could characterize this task as difficult. Would it not have been possible to make it easier? Probably so. If the students had been trained to listen to prosodic cues of French right from the outset of their study when their attention had not yet become blurred, most probably the results of the tests would have improved. It is one thing to listen to prosodic cues and another to pay attention to vocabulary, morphological or syntactic rules. After three months of training, it is already too late to concentrate only on prosody. The students are already used to looking for other information. I would venture to suggest that a group of students starting the study of a foreign language would perform better provided they receive right at the outset proper training for these global elements of a language. Only a longitudinal study could show this more clearly.

Second, the recording of the French sentences did not constitute the right sample of French rhythm meant for beginners. This does not mean that there was some influence of a kind of dialect or some wrong pronunciation of phonemes. On the contrary, everything could be classified as an honest sample of standard modern French. But the different sentences did not well represent the basic prosodic features of this language. For instance, specialists agree that the last syllable of each rhythmic group has on average a duration of two and half times longer than any previous syllable. Intensity is steady all through except at the end when the last accentuated vowel is only 0.5 dB lower than the

preceeding ones. These two factors are just the reverse in English, where the accent very seldom falls at the end and the intensity is changing all the time in a significant manner, 4.4 dB of difference between stressed and unstressed vowels (Delattre, 1966, p. 187). A better recording, that is a recording that would have taken more into account these two factors, would undoubtedly have enabled the subjects to make a clearer distinction between English and French. In other words, the recording like the one I was using was meant for advanced learners of French prosody, not beginners.

I would like to add a last remark concerning the type of sentences selected for the tests. They could not properly be called genuine spoken French, English, or Chinese since they dealt with a peculiar situation, that of tourists. Undoubtedly sentences blended with a more important part of affectivity would have helped subjects to select the proper language with more accuracy.

In conclusion, people learning a foreign language have a special "feeling" for the information transmitted through low frequencies below 300 Hz, mainly prosodic features, and that this feeling may develop naturally to a certain extent as was shown by the above experiment. No doubt it could also be further nurtured and developed in such a way that it may become helpful in different ways beyond our expectations.

Finally, I would like to quote a poem on rhythm composed by Doctor Samuel Anderson, a medical doctor working in a psychiatric hospital in New York. This poem is appropriate at the end of this article for we know that rhythm and low frequencies are different sides of the same coin:

Before words come to me,
I get a sense of rhythms,
Something like a time-schema,
Before the words,
I have had a sense of form,
Something into which
The words, as they appear, can fit.

(Quoted from Ferrand-Vidal, 1982, p. 11)

APPENDIX

English Sentences

- 1E I plan to stay for 6 days.
- 2E I have nothing to declare.
- 3E I'd like to change 100 dollars.
- 4E Where is the tourist information office?
- 5E I made a reservation in Tokyo.
- 6E Are there any letters for me?
- 7E I'd like a wake-up call tomorrow at 6 a.m.
- 8E I'm checking out now.
- 9E What are some special products of this town?

French Sentences

- 1F J'ai l'intention de rester pour 6 jours.
- 2F Je n'ai rien à déclarer.
- 3F Pouvez-vous me changer ces 100 dollars?
- 4F Où est le bureau de renseignements?
- 5F J'ai fait la réservation à Tokyo.
- 6F Y a-t-il une lettre pour moi?
- 7F Réveillez-moi à 6 heures demain matin, s'il vous plaît.
- 8F Je vais régler ma chambre maintenant.
- 9F Quelle est la spécialité de cette ville?

Mandarin Sentences

- 1M 我预定位六天。
- 2M 没有什么要申报的东西。
- 3M 请兑换一百美金吧。
- 4M 观光指南在哪儿?
- 5M 在京定好了。
- 6M 有我的信吗?
- 7M 请明天早晨六点钟叫醒我。
- 8M 请给我结账。
- 9M 这个城市的特产是什么?

Bibliography

- ASP, C. and GUBERINA, C. (1981) The Verbo-tonal Method for Rehabilitating People with Communication Problems (New York: World Rehabilitation Fund, Inc.)
- ATKINSON, K. (1968) Language identification from non segmental cues. Working Papers in Phonetics (UCLA) 10, 85-89.
- BONTE, R. (1975) Can you identify a language by its prosody? (Unpublished MA thesis, University of California).
- BROESTERHUIZEN, M. L. H. M. Van Dijk, J.P.M. and IJSSELDIJK, F.J.W. (1981) Psychological and educational diagnosis and assessment. In A. M. Mulholland, (Edt), Oral Education Today & Tomorrow (Washington: The Alexander Graham Bell Association for the Deaf) 409-447.
- BUSH, C. (1967) Some acoustic parameters of speech and their relationships to the perception of dialect differences. TESOL Quarterly, 1, 20-30.
- COHEN, A. and STARKWETHER, J. (1961) Vocal cues to the identification of language. American Journal of Psychology, 74, 90-93.
- DELATTRE, P. (1966) A Comparison of Syllable Length Conditioning among Languages. International Review of Applied Linguistics in Language Teaching, IV, 3, 183-199.
- FRANKLIN, B. (1969) The effect on consonant discrimination of combining a low-frequency passband in one ear and a high-frequency passband in the other ear. The Journal of Auditory Research, 9, 365-378.
- FRANKLIN, B. (1979) A comparison of effect on consonant discrimination of combining low- and high-frequency passband in normal, congenital and adventitious hearing-impaired subjects. Journal of the American Auditory Society, 5, 168-176.
- FERRAND-VIDAL, A.-M. (1982) La mélodie-thérapie du langage (Paris: Maloine S.A. Editeur).
- GUBERINA, P. (1983) Govorni Jezik i pisani jezik (Zagreb: Hrvatski Jezik).
- GUBERINA, P. (1964) Verbo-tonal method and its application to the rehabilitation of the deaf. Report of the proceedings of the International Congress on Education of the Deaf (Washington, DC: U.S. Government Printing Office) 279-293.
- GUBERINA, P. (1973) Les appareils Suvag et Suvag Lingua. Revue de Phonétique Appliquée, 27-28, 7-16.
- GUBERINA, P. (1985) The Role of the Body in Learning Foreign Languages. Revue de Phonétique Appliquée, 73-74-75, 37-50.

HUIZING, H. C. (1959) Deaf Mutism: Modern trends in Treatment and Prevention. Annals of Oto-Rhino-Laryngology, 5, 74-106.

LING, D. (1964) Implications of Hearing Aid Amplification below 300 cps. The Volta Review, 66, 723-727.

LING, D. (1965) Low-Frequency Amplification. Acta Oto-Laryngologica, 206, 232-237.

MAIDMENT, J. (1976) Voice fundamental frequency characteristic as language differentiators. Speech and Hearing Work in Progress (London: University College) 2, 74-93.

OHALA, J.J. and GILBERT, J.B. (1979) Listener's ability to identify languages by their prosody. In P. LEON and M. ROSSI (Eds), Problèmes de prosodie, v. II, Expérimentations, Modèles et fonctions, Studia Phonetica 18 (Ottawa: Didier) 123-131.

PORTMANN, M. and PORTMANN, C. (1972) Précis d'audiométrie clinique (Paris: Masson et Cie, Editeurs).

RAKOWSKA-JAILLARD, C. (1982) Entendre (Paris: Editions Universitaires).

RICHARDSON, J.A.C. (1973) The identification by voice of speakers belonging to two ethnic groups (Unpublished PhD thesis, Ohio State University).

ROSENTHAL R. D., LANG, J. K. and LEVITT, H., (1975) Speech reception with low-frequency speech energy. Journal of the Acoustic of America, 57, 949-955.

TROCME, H. (1973) Le Suvag Lingua de classe dans l'enseignement de l'anglais aux adultes français. Revue de Phonétique Appliquée, 27-28, 45-54.

WATSON, T. J. (1961) The Use of Residual Hearing in the Education of Deaf Children. The Volta Review, 63, 238-334.